Altruism Networks and Economic Relations

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Abstract: What patterns of economic relations arise when people are altruistic rather than strategically self-interested? What are the welfare implications of altruistically-motivated choices of business partners? This paper introduces an altruism network into a simple model of choice among partners for economic activity. With concave utility, agents effectively become inequality averse towards their friends and family. Rich agents preferentially choose to work with poor friends despite productivity losses. These preferential contracts can also align with welfare since the poor benefit the most from income gains and these gains can outweigh the loss in output. Hence, network inequality—the divergence in incomes within sets of friends and family—is key to how altruism shapes economic activity, output, and welfare. When skill homophily —the tendency for friends to have the skills needed for high production—is high, preferential contracts and productivity losses disappear since rich agents have poor friends with the requisite qualifications.

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I Introduction

Economists now recognize that social relations structure many economic transactions. Informal lending tracks family and friendships, job referrals of family and friends are an integral part of the labor market, and family firms are ubiquitous in both developing and developed economies.[1] Much analysis of socially-based economic transactions assumes that individuals are self-interested and engage in repeated games. In "relational contracting," for example, the parties produce and pay for output across time, and the contract is "informally enforced" by the credible threat of ending the relationship, finding another partner, or entering the market if a party reneges.[2] This paper takes a different tack and asks what production patterns emerge when people are modeled as altruistic and care about the well-being of friends and family. This study then arguably examines how this key features of human societies shapes economic relations.

This paper studies how altruism for others—for family, friends, co-ethnics, and even compatriots—shapes contracting and investment, especially in the face of economic downturns. We build a model where individuals care about the well-being of friends and family and analyze the implications of this altruism for the choice between arms-length economic relations and economic relations with friends and family. We analyze the main drivers of what we call *preferential contracts*, economic relations that yield altruistic gains but lower levels of output.

The analysis shows that the interplay between the altruism network and the income distribution shapes preferential contracting. With decreasing marginal utility of consumption, altruistic agents effectively become inequality averse towards their friends. In an economic downturn which impacts the poor, investors are more willing to sacrifice economic gains in order to support their poorer friends and family. Thus, the expansion in preferential contracting depends on the divergence or similarity of the incomes of friends and family,

[1]See, for example, respectively Ambrus et al. (2014), Karlan et al. (2009), Calvó-Armengol and Jackson (2007), Bertrand and Schoar (2006).

[2]See e.g., Ghosh and Ray (1996), Kranton (1996b), Kranton (1996a)), Baker et al. (2002). Informal lending is similarly sustained by the credible withdrawal of further loans and of social support, by not only the cheated party but by the larger set of friends, family, and neighbors (Jackson et al. (2012)). The value of partnerships is bounded by the largest possible social punishment (Ambrus et al. (2014)).

and hiring friends and family occurs more often when *network income inequality*, which we define, is higher.

The predictions from this study are the opposite of those from strategic models of informal relations, especially following shocks to incomes. In much literature on informal contracts, risk sharing, and favor exchange, the "enforceability constraint" referred to above puts bounds on economic exchanges with others especially when shocks are large, since large obligations would give parties greater incentive to renege.[3] The modeling and analysis in the present paper flip these predictions on their heads. Here, shocks to the income distribution which increase the inequality among friends and family leads to more preferential contracting. Rich agents are more likely to engage family and friends the more their incomes diverge. While derived in a reduced-form model (described below) the results give the main drivers of increased economic engagement with poorer relations and correspond to a diverse set of empirical findings, discussed next.

Empirical studies find that people do, at personal costs, directly provide favorable economic opportunities to disadvantaged family members.[4] In an employment context, Kramarz and Skans (2014), using Swedish data, find parents appear to trade off higher wages for their children's employment. Children are more likely to be employed at their parent's plant when the child has otherwise weak job prospects (e.g., low grades, economic downturns). Parents' wage growth drops exactly when the child enters the plant, despite that the firm's profits are growing. Altruism towards family members could also be at play in family firms, which play a first-order role in economies (about thirty percent of large firms in wealthy countries under family control (La Porta et al. (1999))). The literature on family firms presents efficiency reasons for hiring family and friends, including information advantages and social norms which substitute for possibly weak legal institutions. Yet,

[3] See for example Coate and Ravallion (1993) for bilateral insurance and Bloch et al. (2008) for informal insurance in a network setting. See Dixit (2003) for a theoretical treatment of exchange contract enforcement inside and outside a community. Wealthy individuals, who have less benefits from the on-going relationship, do not participate; they essentially exit the family or community, Munshi and Rosenzweig (2016), Barron et al. (2020).

[4] De Weerdt and Fafchamps (2011) studies monetary transfers (rather than employment or other preferential treatment) in Tanzania and finds that people give direct transfers to family and friends who suffer long and persistent health shocks indicating that altruism, rather than a reciprocated insurance arrangement, is operative.

there is mixed evidence that family firms are more productive (Bertrand and Schoar (2006)) and productivity losses arise when family of the firm's founder succeeds as the firm's CEO (Pérez-González (2006), Morck et al. (2007)). Using data on Danish family firms, Bennedsen and Wolfenzon (2007) causally identifies the negative consequences from hiring a new CEO from within the family. The CEO likely has inferior managerial talent relative to the market; after coming on board, the drop in firm profitability on assets is substantial, and the effect is pronounced in fast-growing industries, industries with highly skilled labor force, and relatively large firms.[5]

Altruism has appeared in economic analyses at least as far back as Becker (1974). Early studies focused on the role of altruism in the nuclear family and between parents and children, in particular. More recent empirical studies on informal safety nets showed that support relationships often include wider sets of people such as as friends, neighbors, and the extended family, see, e.g., Fafchamps and Lund (2003), De Weerdt and Dercon (2006), Fafchamps and Gubert (2007). Moreover, altruism appears to be a main motive behind such support, see, e.g., Foster and Rosenzweig (2001), Leider et al. (2009), Ligon and Schechter (2012). Motivated by these facts, a recent literature revisits economic models of altruism, where agents directly care about others' well being, see Galperti and Strulovici (2017), Ray and Vohra (2020), and Vásquez and Weretka (2020). Bourlès et al. (2017) provides the first analysis of altruism in networks, and we adopt similar assumptions on altruistic preferences. While Bourlès et al. (2017) studies how altruism affects monetary transfers, the present paper provides an analysis of the impact of altruism networks on economic relationships.

The present paper considers how altruism shapes economic relations such as investment and employment. We build a reduced form model of production opportunities which require combining individuals' resources, such as skilled labor and specialized capital. Particular pairings can then produce different levels of output.[6] The analysis studies the choice among

[5] Emigrants who invest in businesses and financial instruments (e.g. diaspora bonds) in their country-of-origination, especially following disasters or during economic crises, are another example of the willingness of people to forgo higher investment returns in order to aid those to whom they feel a connection (Ketkar and Ratha (2007)).

[6] Examples would include (i) employing a family member versus a more qualified worker, (ii) contracting with a relative or friend's firm versus a more technologically appropriate firm, and (iii) direct investment

possible partnerships in a simple model with altruism towards friends and family and an ex ante income distribution. Engaging a "qualified" agent yields the highest possible economic return; engaging an unqualified friend entails an economic loss but a gain in altruism payoffs. We assume that direct transfers of income are not possible, and contracting is the only way agents help friends and family. Even if some transfers were possible, the forces at play hold to the extent monetary transfers involve frictions.[7]

We consider two types of economies which differ on whether friends and skills overlap - what we call *skill homophily*. In the first economy, agents have no friends who are qualified to produce the high levels of output; there is no skill homophily. This model represents a highly specialized large economy, and investors choose between qualified agents and unqualified friends. In the second economy, agents can have qualified agents among their friends, representing a small, less specialized economy, such as the economy of a village. With skill homophily, investors have a more complicated choice, since they can choose among qualified agents, and qualified and unqualified friends.

The analysis of the economy with no skill homophily shows the central role network inequality plays in preferential contracting. Agents with a production opportunity choose between a qualified agent and an unqualified friend. Since agents are effectively inequality averse, they ultimately choose between a qualified agent and their poorest friends. In the special case of constant absolute risk aversion, we identify a network measure of inequality that relates directly to the level of preferential contracting. This measure captures the overall probability there is given difference between investors' incomes' and those of their friends. The greater the tendency for friends to have similar income levels, *income homophily*, the lower is this overall probability and the less frequent is preferential contracting. Moreover, the minimum income among friends is what matters, and this finding implies that preferential contracting can be quite prevalent even with high overall income homophily.

In an economy where people have less specialized skills so that agents can have qual-

in friends' or families' business ventures versus investing in a firm with the highest return to capital.

[7]The assumption of no monetary transfers follows the literature on the reluctance of individuals to monetize the help they give one another, see e.g., Prendergast and Stole (2001). Bourlès et al. (2017) analyze frictionless monetary transfers induced by altruism.

ified partners among their friends, we find a non-monotonic relationship between income homophily and preferential contracting. When rich agents are only linked to rich agents, there is no preferential contracting. When rich agents have some friends who are poor, they are more likely to engage in preferential contracting. However, when rich agents have many poor friends, there is likely to be a poor friend who is qualified and hence the rate of preferential contracting falls. Thus, in a village-like economy where production requires possibly less precise matching of skills, preferential contracting is largest with intermediate range of income homophily.

In both settings, the analysis shows that preferential contracting can actually increase (utilitarian) welfare, despite the loss in output. Since agents' have decreasing marginal utility of income, contracts with the poorest agents have the highest gain in utility that would counter a loss in output. Investors' incentives can thus be aligned with social welfare; investors are effectively inequality averse and preferentially contract with their poorest friends. In the large specialized economy, there are welfare gains from preferential contracting when network inequality is sufficiently high (rich agents are altruistic towards the very poorest agents). In the less specialized, village economy, the welfare impact depends on both skill and income homophily. Contracts between rich agents and poor qualified agents yield the highest welfare gains, since the impact on utility is highest with no loss in productivity. The probability a rich investor has a poor qualified friend is then critical to the effect of the investors' decision on welfare.

The paper proceeds as follows: Section II provides the basic model of altruism and contracting. Sections III and IV consider the two types of economies, one in which no friends are qualified and one in which some friends are qualified. The Conclusion discusses directions for future research in light of the results.

II The Model: Altruism and Contracting

We introduce a model to study how altruism shapes investment and contracting patterns. In this model, agents care about other agents whom we will refer to collectively as their *friends*. A subset of agents has production opportunities, and they choose with whom to engage in economic activity. Choosing to work with friends, while possibly less productive, increases utility through altruistic returns. We next formally specify altruism networks, production opportunities, and payoffs.

Agents, Utility, and Altruism. Society is composed of a set of N agents, with $|N| = n$. Each agent i has initial income y_i and final consumption worth c_i which includes gains from any economic activity conducted in partnership with another agent. Each agent agent has a strictly increasing and strictly concave private utility function over own consumption $u : \mathbb{R}_+ \to \mathbb{R}$. Each agent i also possibly cares about the utility of other people in the society. Following Becker (1974) and Bourlès et al. (2017), agent i's overall utility is

$$v_i(c_i, \mathbf{c}_{-i}) = u(c_i) + \sum_{j \neq i} \alpha_{ij} u(c_j),$$

where $\alpha_{ij} \in [0, 1[$ describes the strength of i's altruism towards j. Agents i and j are *friends* if $\alpha_{ij} > 0$, and $N_i = \{j | \alpha_{ij} > 0\}$ denotes i's set of friends. Let $\boldsymbol{\alpha} = (\alpha_{ij})_{i,j}$ denote the altruism network, i.e., the collection of altruistic ties. In most of our analysis, we view the altruism network as given. The friendship ties could also be obtained as a realization of a random network model which relates the probability of friendships to individuals' income levels. We employ such random networks in Section IV.

Economic relations. A subset of agents M—*investors*—have the chance to partner with another agent to produce economic output. For each investor, each production opportunity arrives with an identified *qualified agent* who has the particular skills or other idiosyncratic features which, in partnership with the investor, produces output 2π. Partnering with an agent who is not qualified yields output of only $2f\pi$ where $f < 1$. Another feature of the network is the potential productivity of any two given agents. Let $s_{ij} \in [0, 1]$, which we call *skills links*, be the probability that agent i has a production opportunity and agent j is qualified to work with agent i. Let $\boldsymbol{s} = (s_{ij})_{i,j}$ be the collection of skill links, which we will call the *skill network*. Let S_i denote the agents who could be qualified to work with agent i i.e., $S_i = \{j | s_{ij} > 0\}$. The probability that agent i is an investor is $\sum_j s_{ij}$, so the set of investors is then $M = \{i | \sum_j s_{ij} > 0\}$.

We consider a period of time with one production opportunity, and hence $\sum_{i,j} s_{ij} = 1$. In this period of time, one investor-qualified agent pair is realized and the investor makes a choice of contracting, as described below. We then consider the expectation over all possible investor-qualified agents pairs.[8]

As discussed in the Introduction, we consider two economies distinguished by whether skills are related to friendships. We start our analysis in Section III with a benchmark case with networks in which friends are never qualified, $N_i \cap S_i = \varnothing$. This case could represent, for instance, an economy where skills are highly specialized. We study the case where friends can be qualified in Section IV and consider variation in what we call *skill homophily*, where friends are more or less likely to be qualified partners defined formally below.

Partnerships and preferential contracting. In the given time period, one investor-qualified agent pair is realized. The investor chooses with whom to partner, and we assume that output is shared equally between the two agents. Equal sharing could arise from social norms (Young and Burke (2001)) or from frictions in bargaining (Bramoullé and Goyal (2016)). We assume that any two agents who engage in production cannot transfer income or any of their gains to third parties. This non-transferability could be due to high transactions costs, the impossibility of monetizing non-pecuniary gains and/or social norms which reduce the value of transfers. Similar assumptions underlie the analyses of Bramoullé and Goyal (2016), Jackson et al. (2012) and Duernecker and Vega-Redondo (2018). With non-transferable economic returns, the choice of a partner is the only margin through which an investor can affect the utility of others.

We call a partnership between agent i and an unqualified friend a *preferential contract*, which entails a loss in output. Conditional on the realization of a production opportunity for investor i with qualified agent j, let $q_{ij} = 0$ if investor i partners with j and let $q_{ij} = 1$ if i partners instead with an unqualified friend. Then $q_i = \sum_j s_{ij} q_{ij}$ denotes the *ex-ante* probability investor i chooses a preferential contract, and $q = \sum_i q_i$ denotes the overall *ex-ante* probability of preferential contracting. Expected output is then

[8] The period of time is correspondingly small and may notably depend on population size, as in Jackson, Rodriguez-Barraquer & Tan (2012).

$$\Pi = \sum_{i,j} s_{ij}((1-q_{ij})2\pi + q_{ij}2f\pi) = 2\pi(1-q(1-f)).$$

and is linearly decreasing in the probability of preferential contracting.

Our main objective is to analyze the pattern of preferential contracting under different economic and social conditions. When does an investor engage in preferential contracting? How does this decision depend on income-based homophily and skill homophily? How do shocks to the income distribution affect contracting and expected output levels?

III Friends Are Never Qualified

We first study a society where $N_i \cap S_i = \varnothing$. (Equivalently, for all i, for $j \in N_i$, $s_{ij} = 0$.) We analyze the incentives of a specific investor i to contract with a friend rather than a qualified agent j and then consider the overall probability of such preferential contracts.

A Individual Investor Decisions, Production, and Welfare

Consider investor i and a qualified agent j. Investor i decides whether to partner with j or to contract with a friend. If i partners with j, i earns overall utility

$$v_i = u(y_i + \pi) + \sum_{l \in N_i} \alpha_{il} u(y_l).$$

If i partners with an arbitrary friend k, i's overall utility is

$$v_i = u(y_i + f\pi) + \alpha_{ik} u(y_k + f\pi) + \sum_{\substack{l \in N_i \\ l \neq k}} \alpha_{il} u(y_l) = u(y_i + f\pi) + \alpha_{ik}[u(y_k + f\pi) - u(y_k)] + \sum_{l \in N_i} \alpha_{il} u(y_l)$$

The friend k which maximizes this latter utility is the solution to

$$\max_{k \in N_i} \alpha_{ik}[u(y_k + f\pi) - u(y_k)].$$

The investor's choice among her friends involves two considerations. First, the investor gains more when she chooses a friend k towards whom she has higher altruism (higher α_{ik}). She also gains more from choosing a friend k is poorer (lower y_k), since u is strictly concave. Hence, there is a trade-off between i's altruism and a friend's gain in utility, which is higher when the friend is poorer. For instance, when utility displays Constant Absolute Risk Aversion, $u(y) = -e^{-Ay}$, a specification we will also be employing below, this maximization is equivalent to

$$\min_{k \in N_i} y_k - \frac{\ln(\alpha_{ik})}{A};$$

a doubling of altruistic strength is equivalent to a reduction in initial income of $-\ln(2)/A$. In general, if investor i is equally altruistic towards all her friends – a case we call *equal altruism* $\alpha_{ij} \in \{0, \alpha\}$ for all i,j – contracting with her poorest friend would give the highest utility.

In what follows, let k_i^* denote a solution to the previous maximization problem and call k_i^* agent i's *preferred friend*. While there might be several agents k_i^*, we will refer to this agent in the singular without loss of generality. Investor i's corresponding overall utility from choosing to partner with k_i^* is

$$v_i(k_i^*) \equiv u(y_i + f\pi) + \alpha_{ik_i^*}[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})] + \sum_{l \in N_i} \alpha_{il} u(y_l).$$

Comparing $v_i(k_i^*)$ to the utility earned when contracting with a qualified agent j, i will contract with her preferred friend if and only if

$$\alpha_{ik_i^*}[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})] \geq u(y_i + \pi) - u(y_i + f\pi); \tag{1}$$

investor i's gain from the preferential contract exceeds i's personal economic returns from contracting with qualified agent j.

We derive q_i, the overall probability that i engages in a preferential contracting. We use an indicator variable to capture when the investor i's utility from preferential contracting is higher than contracting with the qualified agent j. Applying the probabilities to the pairings of investors to qualified agents, we then have:

Lemma 1 *The probability that i engages in preferential contracting is:*

$$q_i = \left(\sum_j s_{ij} \right) \mathbb{1} \left(\alpha_{ik_i^*} [u(y_{k_i^*} + f\pi) - u(y_{k_i^*})] \geq u(y_i + \pi) - u(y_i + f\pi) \right). \quad (2)$$

where $\mathbb{1}(I) = 1$ if inequality (I) is satisfied and 0 otherwise.

We now consider how this probability relates to underlying model parameters. Detailed proofs are presented in Appendix.

Proposition 1 *Suppose $N_i \cap S_i = \varnothing$. The probability that investor i engages in preferential contracting, q_i, increases weakly if*
(1) Less output is lost from contracting with an unqualified agent (f increases).
(2) The investor has greater altruism toward her preferred friend ($\alpha_{ik_i^*}$ increases).
(3) The income of investor i increases and/or the income of her preferred friend decreases (y_i increases and/or $y_{k_i^*}$ decreases).

Proposition 1 gives the basic forces driving preferential contracting. The incentives for preferential contracting directly increase if, first, investor i cares more about her friends and if, second, the foregone output is reduced. Third, as a consequence of altruism and concave utility, investors are essentially inequality averse towards their friends. The incentives for preferential contracting therefore increase if i becomes richer and/or if her friends become poorer.

Next we show that despite losses in output, individual incentives for preferential contracting can align with utilitarian welfare.[9] Since agents' utilities are concave, preferential contracting can improve welfare when the friend who benefits is much poorer than the qualified agent.

[9] In this study of welfare, we maintain the assumption that agents cannot make direct transfers of income earned through productive activities. Any gain in welfare comes from the utility gains of the two agents involved in the contract.

We consider welfare as the sum of private utilities:[10]

$$W = \sum_i u_i$$

We assume $\pi \ll y$ (which simplifies the mathematics but does not affect the insights).

Consider the following impacts on welfare of i's possible hiring decisions. If investor i hires the qualified agent j, welfare increases by $\pi u'(y_i) + \pi u'(y_j)$. Hiring another agent k involves a lower level of output and a gain of welfare of $f\pi u'(y_i) + f\pi u'(y_k)$, which is highest when k is the poorest agent in the population, i.e., $y_k = y_{\min}$. Hence, if $fu'(y_{\min}) > (1-f)u'(y_i)+u'(y_j)$, agent i hiring the poorest agent would yield a greater welfare increase. By the same logic, agent i hiring preferred partner k_i^* increases welfare more than hiring qualified agent j when k_i^* is sufficiently poorer than j such that $fu'(y_{k_i^*}) > (1-f)u'(y_i) + u'(y_j)$.

B Altruism Networks and Preferential Contracting

Since friends' relative incomes are key to preferential contracting, this section studies the relationship between contracting, the altruism network, and the income distribution.

B.1 Altruism and Income Distribution

We first consider changes to incomes, as might occur in times of economic expansion or contraction. If investors become richer and their friends become poorer, Proposition 1 shows that preferential contracting increases. However, the result is silent on situations where both an investor's income and her friends' incomes increase or decrease, with possibly countervailing incentives for investors to hire friends.[11]

We identify circumstances where changes to the income distribution lead all investors to expand or reduce preferential contracting. Suppose that individuals have CARA utility

[10]In the literature on welfare evaluation, researchers argue that social preferences should not be taken into account when evaluating welfare, to avoid double-counting and putting more weight on selfish agents (see, e.g., Blanchet and Fleurbaey (2006)).

[11]The result is also silent on situations where an agent can be an investor is some states of world and the preferred friend of an investor in other states of world.

$u(y) = -e^{-Ay}$. Consider first changes to initial incomes which preserve ranks in the income distribution. For shocks which lead to an overall reductions in incomes, let $y_i' = y_i - x(y_i)$ with $x(.) > 0$. A common shock that lowers all income equally would be $y_i' = y_i - x_0$. For $x(.) > 0$ continuously differentiable on $\mathbb{R}_+$, if $x' < 0$ the loss is larger for poorer agents while if $0 < x' < 1$ the income loss is larger for richer agents. In both cases, if $y_k < y_i$ then $y_k' < y_i'$. We assume that altruism levels for investors are not high enough for investors to hire a richer unqualified friend: For the set of investors, let $\bar{\alpha}$ denote the highest level of altruism any investor has for any friend: $\bar{\alpha} = \max_{i \in M, j \in N_i} \alpha_{ij}$ and suppose $\bar{\alpha} < \frac{1-f}{f}$.

Proposition 2 *Suppose $N_i \cap S_i = \varnothing$ and suppose that altruism levels are such that investors never hire friends whose income is higher than their own. Under CARA utility, rank-preserving negative income shocks increase (decrease) preferential contracting for all investors when the shocks affect the poor (rich) more and have no impact on preferential contracting when the shocks are common.*

We can characterize the impact of positive income shocks through similar arguments. Under CARA utility, positive shocks which affect the rich more lead to an expansion of preferential contracting for all investors. Positive shocks which affect the poor more, while still preserving income rank, lead to a reduction in preferential contracting for all investors. In the Appendix, we also partially extend Proposition 2 to utility functions displaying Decreasing Absolute Risk Aversion (DARA). If payoffs and shocks are small relative to incomes, a common negative shock or a negative shock which affects the poor more both lead to an expansion of preferential contracting for all investors. Under DARA, utility is more concave for poorer agents and this concavity increases the relative altruistic benefits of hiring a friend when the poor become relatively poorer.

B.2 Income Shocks and Network Inequality

Studying rank-preserving income changes provides conditions under which incentives for all investors move in the same direction. In general, of course, income rank is not necessarily preserved during economic booms or busts. Some agents might then have increased incentives to hire friends since relative incomes diverge, while others have reduced incentives.

The overall impact of shocks on the preferential contracting and loss in output depend on an aggregate assessment of these increases and decreases.

To consider possibly arbitrary changes in the income distribution, we consider a benchmark special case in which investors are symmetric but for their income levels and those of their friends. Assume equal altruism ($\alpha_{ij} \in \{0, \alpha\}$ for all i,j). Suppose further all investors are equally likely to have a production opportunity $\forall i \in M, \sum_j s_{ij} = 1/|M|$, an assumption we call *equal opportunities*. Let $\Delta \equiv \frac{-\ln(\alpha)}{A} + \frac{1}{A}[\ln(e^{-Af\pi} - e^{-A\pi}) - \ln(1 - e^{-Af\pi})]$. Note that Δ decreases when α or f increases. Moreover, $\lim_{\alpha \to 0} \Delta = \lim_{f \to 0} \Delta = +\infty$, and hence $\Delta > 0$ when α or f is not too high, and we consider only parameters in this range.

To see the impact of these changes, we develop a measure of network income inequality as follows. Consider a set of agents E and each agent $i \in E$, and let $y(N_i)_{min}$ be the lowest income among i's friends. With the equal altruism assumption above, i's preferred friend k_i^* is i's poorest friend, with income $y(N_i)_{min}$. For a given income difference $x \geq 0$, let $F(x; E)$ denote the proportion of agents in E for whom $y_i - y(N_i)_{min} \leq x$. For a fixed network, $F(x; E)$ is a simple fraction of agents in E for any given x. A random network would exhibit income homophily when the probability of link between i and j is a decreasing function of $|y_i - y_j|$.[12] Network inequality $F(x)$ is then a distribution which derives from this random process.

Using this measure of network inequality, we derive a simple expression of the probability of preferential contracting:

Proposition 3 *Consider CARA utility and $N_i \cap S_i = \varnothing$. Suppose $\alpha_{ij} \in \{0, \alpha\}$ for all i,j, and $\forall i \in M, \sum_j s_{ij} = 1/|M|$. Then the overall probability of preferential contracting in the economy is*

$$q = \frac{1}{|M|} \sum_{i \in M} \mathbb{1}[y_i - y(N_i)_{min} \geq \Delta] = 1 - F(\Delta; M).$$

Proposition 3 relates the probability of preferential contracting directly to the measure of network inequality: $1 - F(\Delta; M)$ is equal to the proportion of investors whose income difference with their poorest friends is greater than or equal to a threshold value $\Delta > 0$.

[12] See, for example, Lusher et al. (2012) and Powell et al. (2005) for homophily as the absolute difference of a continuous variable.

The probability of preferential contracting, $1-F(\Delta; M)$, then varies inversely with income homophily, i.e., the tendency of agents with similar incomes to be friends. In a network where investors are more likely to have friends with similar incomes, there are low levels of preferential contracting. By contrast, preferential contracting is prevalent when investors have friends who are much poorer than themselves. For instance, suppose that income is binary, $y_i \in \{y_L, y_H\}$, and that $0 < \Delta < y_H - y_L$. In that case, $y_i - y_{k_i^*} \geq \Delta$ if and only if investor i is rich, $y_i = y_H$ and k_i^* is poor, $y_{k_i^*} = y_L$. By Proposition 3, the probability of preferential contracting is then simply equal to the proportion of investors who are rich and have a poor friend.

We illustrate Propositions 2 and 3 in Figure 1 using simulations of a random network model. There are 50 rich and 50 poor agents. We assume CARA utility, equal altruism, and equal opportunities. The income of a rich agent is picked uniformly at random in the interval $[20, 25]$. The income of a poor agent is picked uniformly at random in $[10, 15]$. We assume utility function parameters such that $\Delta = 16$. We consider shocks affecting poor agents only, of sizes increasing from 0 to 10. We consider two possible stochastic networks. For *no income homophily* (plain curves), any two agents can be connected with probability 0.1. In expectation, any agent is connected with about 10 friends and connections are independent of income. For *income homophily* (dashed curve), we posit any two agents in the same income class are connected with probability 0.18 while any two agents in different incomes classes are connected with probability 0.02. In expectation, a rich agent is thus connected with about 9 rich friends and 1 poor friend. In each case, we pick $1,000$ networks at random and compute the probability of preferential contracting q for each network. Note that with these parameter values, preferential contracting will only occur between a rich investor and a poor friend, and hence $q \leq 0.5$. We depict how the average value of q across all simulated networks varies with shock size, as well as a 95% confidence interval.

We see that the average probability of preferential contracting is increasing with shock size, consistent with Proposition 2. Preferential contracting is a marginal phenomenon when shocks are small, but becomes prevalent when shocks are large. The maximal value of q is reached with no income homophily and large shocks. Consistent with Proposition

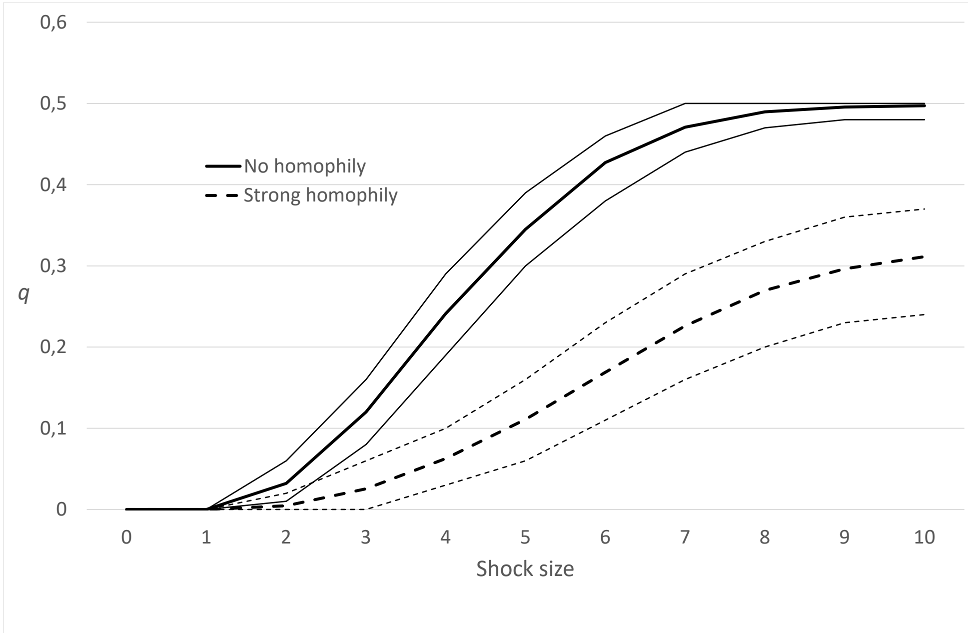

Figure 1: Preferential Contracting and Shocks when No Friends are Qualified

3, the probability of preferential contracting is lower when there is income homophily. Yet, this probability is still quantitatively quite high even though homophily is strong. A rich investor needs only one poor-enough friend in order to engage in preferential contracting; the minimum income among friends is what matters, not the average or the median. Thus, we expect more income homophily to lead to less preferential contracting in societies where friends are never qualified agents.

The relationship between income homophily and preferential contracting, however, is more complex is a society where friends can be qualified. Hiring a poor qualified friend is the best an investor can do, earning both altruistic returns and high economic returns. Having a large number of poor friends would then reduce preferential contracting. We explore this possibility in the next section.

IV Friends Can Be Qualified

Suppose now that investors can have qualified friends. When deciding with whom to partner, an investor has a more complex trade-off since the investor both gains altruistic utility and suffers no output loss by hiring a qualified friend. Skill homophily—the relationship between friendships and productivity—is now key to preferential contracting. Formally, when $\boldsymbol{\alpha}$ is fixed we say $\boldsymbol{s'}$ exhibits lower skill homophily than $\boldsymbol{s}$ if $\sum_{j \notin N_i} s'_{ij} \geq \sum_{j \notin N_i} s_{ij}$ for all i and for all i $\forall j \in N_i, s'_{ij} \leq s_{ij}$, that is, under $\boldsymbol{s'}$ for every agent i, i's friends are less likely to be qualified and agents who are not i's friends are more likely to be qualified.

A Individual Investor Decisions, Production, and Welfare

Consider now an investor i's decision with whom to contract when i has a qualified friend j.

Suppose, first, that j is i's preferred friend k_i^*. In this case, monetary and altruistic incentives are aligned: investor i chooses to contract with k_i^* and

$$v_i(k_i^* = j) \equiv u(y_i + \pi) + \alpha_{ik_i^*} u(y_{k_i^*} + \pi) + \sum_{\substack{l \in N_i \\ l \neq j = k_i^*}} \alpha_{il} u(y_l).$$

which is the highest possible utility an investor can earn.

Suppose next that j is not i's preferred friend k_i^*. When deciding with whom to contract, i faces the trade-off between the relatively greater altruistic returns from contracting with k_i^* and the higher economic returns from hiring j. The investor will hire k_i^* if and only if

$$\begin{aligned} v_i(k_i^* \quad \neq \quad j) \equiv u(y_i + f\pi) + \alpha_{ik_i^*} u(y_{k_i^*} + f\pi) + \alpha_{ij} u(y_j) + \sum_{\substack{l \in N_i \\ l \neq j, k_i^*}} \alpha_{il} u(y_l) \geq \\ u(y_i + \pi) + \alpha_{ik_i^*} u(y_{k_i^*}) + \alpha_{ij} u(y_j + \pi) + \sum_{\substack{l \in N_i \\ l \neq j, k}} \alpha_{il} u(y_l), \end{aligned}$$

which is equivalent to

$$\alpha_{ik_i^*}[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})] - \alpha_{ij}[u(y_j + \pi) - u(y_j)] \geq u(y_i + \pi) - u(y_i + f\pi) \tag{3}$$

Since $\alpha_{ij} > 0$, inequality (3) is strictly more demanding than inequality (1); if the investor does not contract with a qualified friend, she will not contract with an unqualified friend.

Deriving q_i, we extend Lemma 1 and Proposition 1 as follows:

Lemma 2 *Suppose that investors can have qualified friends. Then*

$$\begin{aligned} q_i \;=\; & \left(\sum_{j \notin N_i} s_{ij}\right) \mathbb{1}\left(\alpha_{ik_i^*}[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})] \geq u(y_i + \pi) - u(y_i + f\pi)\right) \\ & + \sum_{\substack{j \in N_i \\ j \neq k_i^*}} s_{ij} \mathbb{1}\left(\alpha_{ik_i^*}\left[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})\right] - \alpha_{ij}\left[u(y_j + \pi) - u(y_j)\right] \geq u(y_i + \pi) - u(y_i + f\pi)\right) \end{aligned} \tag{4}$$

Relative to equation (2), equation (4) includes an additional term for the possibility that the qualified agent j is i's friend.

All the results of Proposition 1 hold, as shown below, and we derive three new results which relate to qualified friends. First, q_i increases weakly when y_j (the income of the qualified friend) increases. By the concavity of u, the altruistic gain from contracting with qualified friend j is lower when y_j is higher, reducing the loss from contracting with the preferred (unqualified) friend. Second, this loss is also reduced when i cares less about j. Third, q_i weakly increases when skill homophily is lower. When i has fewer qualified friends, the expected opportunity cost of contracting with a friend falls.

Proposition 4 *The probability that investor i contracts with an unqualified friend, q_i, increases weakly if*

(1) There is less output loss from contracting with an unqualified agent (f increases).

(2) The investor cares more about her preferred friend and/or less about a non-preferred friend ($\alpha_{ik_i^*}$ increases and/or α_{ij} decreases).

(3) The income of the investor increases, the income of her preferred friend decreases and/or the income of a non-preferred friend increases (y_i increases, $y_{k_i^*}$ decreases and/or y_j increases).

(4) The skill links change from s to s' such that s' displays less skill homophily.

Proposition 4 indicates there is a form of competition between i's friends. Hiring a richer qualified friend, i does not suffer a loss in productivity, but hiring a poorer unqualified friend i gains altruistic utility. Thus, incentives to hire a unqualified friend are related to the income distribution among i and her friends.

The welfare implications of preferential contracting track those in the previous section. An agent i who hires a preferred partner k_i^* increases welfare more than by hiring the qualified ideal partner j when k_i^* is sufficiently poorer than j. In the next section, we study how skill homophily and the income distribution affects the likelihood of such preferential contracts.

B Altruism Networks and Preferential Contracting

We examine the importance of the income distribution, income homophily, and skill homophily in a stylized economy where all agents are equally likely to be qualified for any investor but some agents are rich and others are poor. Investors then could have both rich and poor qualified friends. The economy is a formal random graph model (along the lines of the simulated economy presented above) with the possibility of qualified friends.

We find that as income differences increase, there is more preferential contracting. Since investors are effectively inequality averse, they choose to partner with their unqualified poor friends over their qualified rich friends. Furthermore, we find a non-monotonic relationship between income homophily and preferential contracting. When rich investors have no poor friends, there is little preferential contracting. As the rich have greater numbers of friends among the poor, preferential contracting increases. When rich investors have many poor friends, however, preferential contracting falls because there is a higher likelihood that a poor friend is also qualified.

Consider a population of agents who are either *poor* or *rich*, with income $y_i \in \{y_L, y_H\}$, respectively, where $y_L < y_H$. Let λ denote the fraction of poor agents; let $n_P = \lambda n$ denote the number of poor agents; and let $n_R = (1-\lambda)n$ denote the number of rich agents. We consider a friendship network which is random conditional on incomes.[13] Any two poor agents are friends with probability ρ_P, a rich and a poor agent are friends with probability ρ, two rich agents are friends with probability ρ_R, and the formation of friendships are independent events. The parameter ρ controls the expected number of links between poor and rich agents, and hence varies inversely with the level of homophily. We assume agents have equal altruism, α, for each of their friends and we assume that equal opportunities among investors. We further assume that any agent $j \neq i$ is equally likely to be a qualified agent for i; $s_{ij} = \frac{1}{n(n-1)}$ for $i \neq j$. Thus, the skill probabilities are independent of incomes and of friendships. However, as the probabilities ρ, ρ_P, and ρ_R increase, agents have more friends overall, and thus agents are more likely to have qualified friends (skill homophily increases).

We analyze the model in two stages. We first look at how preferential contracting depends on the income distribution, holding the altruism network fixed. We then analyze increases in connectedness which determines income and skill homophily. For simplicity, we assume that $\pi \ll y$ implying that $u(y+f\pi)-u(y) \approx f\pi u'(y)$. Also, denote by $u'_L = u'(y_L)$ and $u'_H = u'(y_H)$ with $u'_L > u'_H$.

B.1 Altruism and Income Distribution

We proceed by considering an investor i's decision to engage a friend.

Suppose first that i's qualified agent j is not a friend, $j \notin N_i$. We focus on the interesting case where altruism is not so strong that a poor investor hires an unqualified poor friend nor a rich investor hires a rich friend. This condition is here $\alpha \leq \frac{1-f}{f}$, since a poor investor would hire an unqualified poor friend if and only if

$$\alpha[u(y_L+f\pi)-u(y_L)] \geq u(y_L+\pi)-u(y_L+f\pi) \Leftrightarrow \alpha f\pi u'_L > (1-f)\pi u'_L \Leftrightarrow \alpha \geq \frac{1-f}{f} \quad (5)$$

[13] This is a classical extension of the Erdős-Renyi model of random graph, see e.g. Golub and Jackson (2010)

with a parallel condition for a rich investor hiring a rich friend. The only preferential contracts that would arise are between rich investors and their poor friends, since if rich investors do not contract with rich friends, poor investors would not either.[14] A rich investor preferentially contracts with a poor friend if and only if

$$\alpha[u(y_L + f\pi) - u(y_L)] \geq u(y_H + \pi) - u(y_H + f\pi) \Leftrightarrow \alpha \geq \frac{1-f}{f}\frac{u'_H}{u'_L}. \tag{6}$$

Second, suppose qualified agent j is a friend of i, $j \in N_i$. If j is poor, then i contracts with j since productivity and altruism incentives are aligned. If j is rich, i prefers to contract with a poor unqualified friend if and only if

$$\begin{aligned} \alpha[u(y_L + f\pi) - u(y_L)] &\geq u(y_H + \pi) - u(y_H + f\pi) + \alpha[u(y_H + \pi) - u(y_H)] \Leftrightarrow \\ \frac{\alpha f}{(1 - f + \alpha)} &\geq \frac{u'_H}{u'_L} \end{aligned} \tag{7}$$

These arguments lead to the following result, which shows how preferential contracting depends on the income distribution through the ratio of marginal utilities $\frac{u'_H}{u'_L}$. When the rich become richer or the poor becomes poorer, this ratio decreases and preferential contracting expands.[15]

Proposition 5 *Assume that $y_i \in \{y_L, y_H\}$, $\pi \ll y$, and $\alpha \leq \frac{1-f}{f}$ so that any preferential contracts are between rich investors and poor friends. Consider an investor i and qualified agent j:*

(1) Strong preferential contracting: If $\frac{u'_H}{u'_L} \leq \alpha\frac{f}{1-f+\alpha}$, a rich investor prefers to hire a poor unqualified friend if j is not a poor friend.

(2) Weak preferential contracting: If $\alpha\frac{f}{1-f+\alpha} \leq \frac{u'_H}{u'_L} \leq \alpha\frac{f}{1-f}$, a rich investor prefers to hire a poor unqualified friend if j is not a friend (poor or rich).

(3) If $\frac{u'_H}{u'_L} \geq \alpha\frac{f}{1-f}$, there is no preferential contracting.

Figure 2 illustrates Proposition 5. Marginal utility of income for rich and poor agents is

[14] The condition for a poor investor contracting with a rich friend is $\alpha \geq \frac{1-f}{f}\frac{u'_L}{u'_H}$.

[15] Proposition 5 directly implies that q is a weakly decreasing, piece-wise constant function of $\frac{u'_H}{u'_L}$ for any realization of the random network model.

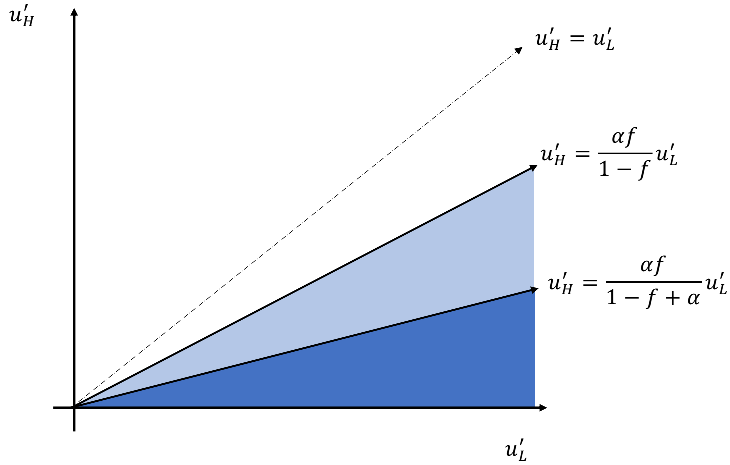

Figure 2: Weak vs. Strong Preferential Contracting

measured on the axes. The darkly shaded region, below the line $u'_H = \frac{\alpha f}{1-f+\alpha} u'_L$, gives the combinations (u'_L, u'_H) where inequality is so large that i contracts with a poor friend (if she has one). The lightly shaded region gives the combinations (u'_L, u'_H) where inequality is still large enough that i contracts with a poor friend (if she has one) but only when she does not have a qualified rich friend.

B.2 Income Homophily

We now consider how the expected probability of preferential contracting depends on the parameters of the random graph model under both strong and weak preferential contracting. We find a non-monotonic relationship between the probability of connection between a rich and a poor agent, ρ, and the extent of preferential contracting in both regimes. When ρ is small, rich investors have few poor friends, hence there is little scope for preferential contracting. As ρ increases, rich investors have more poor friends, who are equally likely to be (un)qualified as any other agent, and the probability of preferential contracting increases. As ρ approaches 1, rich investors have many poor friends and therefore are more likely to have a qualified poor friend with whom to contract.

Proposition 6 *Suppose that agents are poor or rich, $y_i \in \{y_L, y_H\}$, that $\pi \ll y$, and $\alpha \leq \frac{1-f}{f}$ and that friendship links are random conditional on incomes.*
(1) Under strong preferential contracting,

$$\mathbb{E}(q) = (1-\lambda)(1-(1-\rho)^{n_P}) - (1-\lambda)\frac{\rho n_P}{n-1}, \tag{8}$$

(2) Under weak preferential contracting,

$$\mathbb{E}(q) = (1-\lambda)(1-(1-\rho)^{n_P})\left(1-\rho_R\frac{n_R-1}{n-1}\right) - (1-\lambda)\frac{\rho n_P}{n-1}. \tag{9}$$

In both cases, $\mathbb{E}(q)$ is first increasing in ρ from $\mathbb{E}(q) = 0$ at $\rho = 0$ and then decreasing.

Proposition 6 shows how both income and skill homophily affects the probability of preferential contracts. The first term in equation (8) is equivalent to $1-F(\Delta)$ where $\Delta = y_H - y_L$, the proportion of investors whose income difference with at least one friend is $(y_H - y_L)$. This is the probability of preferential contracting that arises in an economy where friends are never qualified. The second term gives a reduction in the probability of preferential contracting thanks to skill homophily, in this case poor qualified friends. The terms in equation (9) have a similar interpretation; the first term is now discounted by the likelihood of rich qualified friends.

For both strong and weak contracting, the probability of preferential contracts is non-monotonic in ρ, since as ρ increases, skill homophily increases and income homophily decreases. Figure 3 illustrates, when $n_R = n_P = 50$. The two curves depict how $\mathbb{E}(q)$ varies with ρ under strong preferential contracting (plain) and weak preferential contracting (dashed), with $\rho_R = 0.5$ in the latter case. Since only rich investors offer preferential contracts, $q \leq 0.5$, and we see that $\mathbb{E}(q)$ reaches at its maximum a significant fraction of this largest possible value - about 95% in the first case and about 70% in the second case. As ρ increases from 0, $\mathbb{E}(q)$ first increases quickly as rich investors have their first poor friends. As ρ further increases, rich investors have more and more poor friends and the likelihood one of them is qualified also increases, decreasing $\mathbb{E}(q)$.

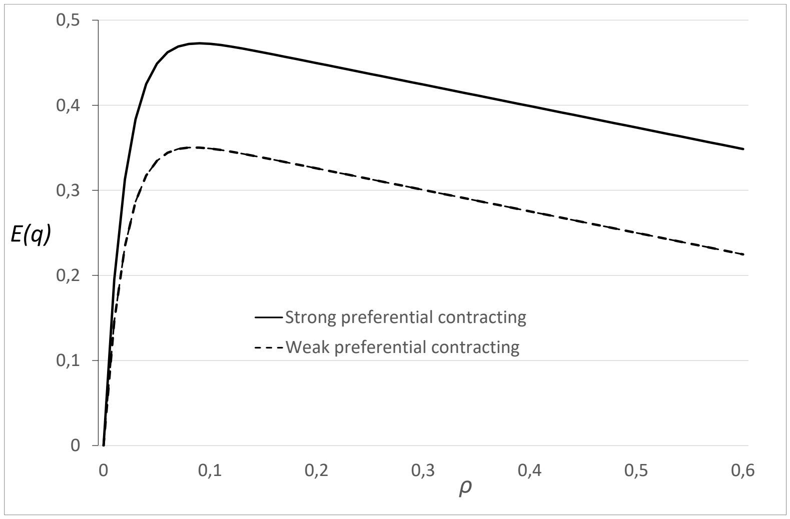

Figure 3: Preferential Contracting in Random Networks

B.3 Welfare, Preferential Contracting, and Income Homophily

Here we study the welfare implications of preferential contracting and income homophily in this model. We compare the expected welfare that arises when an investor chooses with whom to contract vs. the welfare that arises when all contracts are with qualified agents. We denote this difference $\mathbb{E}(\Delta W)$. We consider $\mathbb{E}(\Delta W)$ when the condition for strong preferential contracting is satisfied ($\frac{u'_H}{u'_L} \leq \alpha \frac{f}{1-f+\alpha}$); income inequality is so high that a rich investor hires a poor friend if she has one, be that friend qualified or unqualified. (The analysis of weak preferential contracts is similar and is provided in the Appendix.)

The difference in welfare arises when a rich investor hires an unqualified agent instead of a qualified agent. The differences thus occur when a rich investor hires unqualified poor friend instead of (a) a qualified rich agent (friend or not), or (b) a qualified poor agent who is not a friend. For (a), the gain in welfare from the preferential contract is $f\pi(u'_L + u'_H)$ rather than the gain $2\pi u'_H$which would have accrued from hiring the qualified agent. These preferential contracts therefore entail greater welfare gains only when $fu'_L > (2-f)u'_H$; the poor agents must be sufficiently poor so that the increase in utility outweighs the loss in productivity. For (b), the preferential contract with a poor friend rather than a qualified

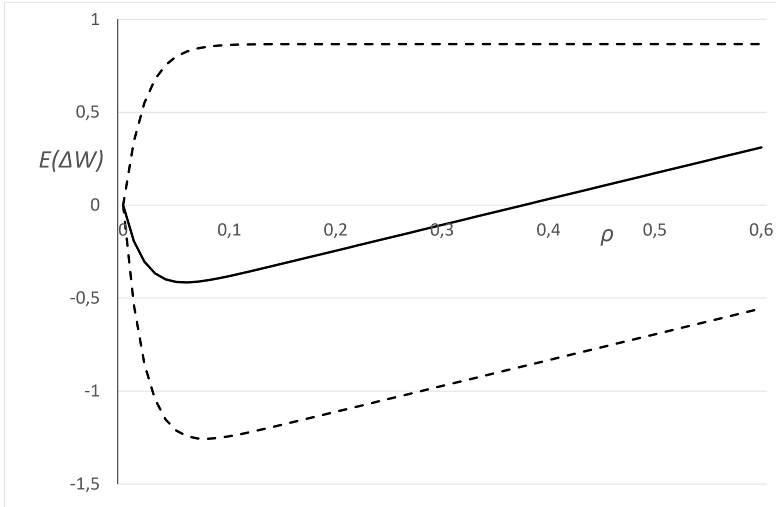

Figure 4: Welfare Impact of Strong Preferential Contracting

poor stranger always entails lower welfare, since there is only a loss in productivity; the preferential contract with the poor unqualified friend yields $f\pi(u'_L + u'_H)$ but the contract with the qualified poor stranger yields $\pi(u'_L + u'_H)$.

Overall, $\mathbb{E}(\Delta W)$ derives from the probabilities of each of these events and the balance of the associated possible gains and losses. We have

$$\mathbb{E}(\Delta W) = (1-\lambda)\pi \quad \Big[\quad \frac{n_R - 1}{n-1}(1-(1-\rho)^{n_P})(fu'_L - (2-f)u'_H) - \frac{n_P}{n-1}(1-(1-\rho)^{n_P} - \rho)(1-f)(u'_L + u'_H)\Big] \tag{10}$$

where recall $(1-\lambda)$ is the proportion of agents who are rich and thus the probability an investor is rich. The first term in the brackets is case (a), where $\frac{n_R-1}{n-1}$ is the probability that the qualified agent is rich and $(1-(1-\rho)^{n_P})$ is the probability a rich investor has at least one poor friend. The second term in the brackets is case (b), where $\frac{n_P}{n-1}$ is the probability the qualified agent is poor and $(1-(1-\rho)^{n_P} - \rho)$ is the probability a rich agent has at least one poor friend but no poor friend is qualified.

The impact on welfare from preferential contracting thus depends on both income inequality (u'_L vs. u'_H) and on the probability of links among agents (ρ), as illustrated in the simulations in Figure 4. The parameter specifications satisfy $fu'_L-(2-f)u'_H > 0$, and the upper dashed curve shows the first term of (10).[16] As ρ increases, there is a greater probability a rich investor has a poor friend who benefits from a preferential contract, and these expected welfare gains plateau as the likelihood of at least one poor friend approaches 1. The lower dashed curve is the second term in (10). For low values of ρ, there is higher probability that a rich investor has at least one poor friend but none of them are qualified. For low ρ, as ρ increases, this likelihood increases, which accounts for the increasingly negative values. Eventually, however, as a rich investor becomes more and more connected to poor agents, the probability a qualified poor agent is among his friends increases, and this expected welfare loss falls. The second term exceeds the first term for low ρ but not for high ρ when $(n_R-1)(fu'_L-(2-f)u'_H) < (n_p-1)(1-f)(u'_L+u'_H)$ as specified in the simulation. The solid curve gives the sum of the two terms and the overall effect on welfare gains of strong preferential contracting

The following proposition summarizes the relationship between income inequality and the altruism network and the welfare impacts of preferential contracting in the random network.

Proposition 7 *For* $\frac{u'_H}{u'_L} \leq \alpha\frac{f}{1-f+\alpha}$ *(strong preferential contracting),*
(1) If $fu'_L-(2-f)u'_H < 0$*, then* $\mathbb{E}(\Delta W) < 0$ *for* $\rho > 0$*.*
(2) If $fu'_L-(2-f)u'_H > 0$ *and if* $(n_R-1)(fu'_L-(2-f)u'_H) > (n_p-1)(1-f)(u'_L+u'_H)$*, then* $\mathbb{E}(\Delta W) > 0$ *for* $\rho > 0$*.*
(3) If $fu'_L-(2-f)u'_H > 0$ *and if* $(n_R-1)(fu'_L-(2-f)u'_H) < (n_p-1)(1-f)(u'_L+u'_H)$*, then there exists a* ρ^* *such that* $\mathbb{E}(\Delta W) < 0$ *if* $\rho < \rho^*$ *and* $\mathbb{E}(\Delta W) > 0$ *if* $\rho > \rho^*$*.*

[16] The parameter values used in the simulation are $f = 0.5$, $u'_L = 10$, $u'_H = 1$, and $n_R = n_P = 50$.

V Conclusion

The model and analysis in this paper show how altruism can shape economic relations and contracting patterns. The results contrast with those of models where agents are strategically self-interested and engage in long-term informal contracts with friends and family. In such models, agents' engagement is limited in the face of large shocks, when the incentive to renege is the highest. In the present paper, agents are altruistic, and this altruism along with diminishing marginal utility, leads investors to act like they are inequality-averse. Thus, investors engage in preferential contracting with their poorest friends and family.

In a large specialized economy, when no friends have the requisite skills for a high-output partnership, agents trade off high productivity for the altruistic gains of employing a poor friend. Shocks which amplify the difference in incomes, and especially hit the poor, increase preferential contracting rates. The divergence in incomes within the altruism network is thus the key statistic in predicting the prevalence of preferential contracting. Investors' incentives can also be aligned with social welfare, since increasing the income of the poor has a highest utility gain which can outweigh the losses from lower output.

In a less specialized, village-like economy, where investors can have friends and family with whom to engage in high-productivity partnerships, the rate of preferential contracting depends on both skill homophily and the distribution of income. Investors in such economies have a more difficult choice: between a qualified agent who is not a friend, qualified friends who can be rich or poor, and unqualified friends. Preferential contracting increases when richer agents are initially more likely to have poor friends, since rich agents gain more in altruistic utility from contracting with poor rather than rich friends. Ultimately, though, the rate of preferential contracting decreases as this probability rises, since the rich are then more likely to have poor friends who are also qualified. These contracts with poor qualified agents lead to the largest gains in welfare.

More generally, our analysis confirms and clarifies the deep interconnections between the economic and social aspects of transactions. Contracts here play a dual role. They contribute to economic output and also, in specific circumstances, are part of the informal safety net. Contracting patterns have both economic determinants (e.g. income shocks, production technologies) and social determinants (structure of the altruism network). The analysis and results thus could guide future empirical research on social ties and economic activity, related to several strands of the literature. Empirical studies of economic "favors" in networks, for example, should focus on the network income distribution and the effect of shocks on this distribution, using the network measure of inequality. The network analysis should also consider whether agents' have connections to people with requisite skills and whether these friends are relatively rich or poor.

For family firms, discussed in the introduction, our analysis suggests that hiring family members in family firms could be a much wider phenomenon. In large firms, hiring could involves the extended family (such as cousins, nieces, grand-nieces) in various positions. Our results yield specific predictions on how such hiring depends on the altruism among family members, the income distribution within the family, individual skills, and the business cycle.

Furthermore, the analysis suggests patterns for many situations where people help their family and friends *through* business interactions. For example, wealthy parents may rent an apartment to their child at below the market rent; family and friends can help kick-start businesses and financially support others' artistic endeavors at a loss relative to other investments; entrepreneurs and academics team up because of social affinities rather than for purely productive reasons.[17] That is, people engaging in many market transactions actually have altruistic, non-market motives.

Our analysis considers both the mechanism and the welfare implications of such motives and transactions. For example, in a large specialized economy, if there is a large dispersal of income within families and among friends, our analysis shows that preferential contracting can increase welfare by increasing the income of the poorest agents, despite losses in productivity. Current empirically observed trends of increasing income homophily and neighborhood and housing segregation by income in the United States, for example, (see, e.g., Putnam (2016)) then push against the welfare-enhancing potential of altruism-based

[17]AlShebli et al. (2018)'s observational study of scientific collaborations finds evidence that ethnic homophily among collaborators is high but publications with ethnically diverse authors have more impact.

economic relations.

The results from our model of partnerships also suggest possible effects of altruism on the business cycle. In particular, family-based safety nets could mobilize during downturns. While preferential contracting aligns with welfare when incomes are sufficiently low, this contracting has negative effects on output. Preferential contracting could therefore have a multiplier effect. Negative shocks may lead to an increase in preferential contracting, which further reduces economic output. This possibility relates to Vásquez and Weretka (2021)'s argument that firms gain from altruism between existing co-workers and therefore limit firings during downturns, with negative effects on labor market performance. More generally, changes in such preferential contracting could amplify or dampen variations in the business cycle, a possibility which should be explored.

APPENDIX

Proof of Proposition 1. (1) By concavity of u, higher y_i leads to lower $[u(y_i+\pi)-u(y_i+f\pi)]$, the incentives for i to choose a qualified agent. By concavity of u again, lower $y_{k_i^*}$ increases $\left[u(y_{k_i^*}+f\pi)-u(y_{k_i^*})\right]$, the incentives to choose agent i's preferred friend.
(2) An increase in $\alpha_{ik_i^*}$ increases $\alpha_{ik_i^*}[u(y_{k_i^*}+f\pi)-u(y_{k_i^*})]$.
(3) An increase in f increases $\alpha_{ik_i^*}[u(y_{k_i^*}+f\pi)-u(y_{k_i^*})]$ and reduces $u(y_i+\pi)-u(y_i+f\pi)$. QED.

Proof of Proposition 2. With $N_i \cap S_i = \varnothing$ and CARA utility, investor i hires a friend if and only if

$$y_i - y_{k_i^*} \geq \frac{-\ln(\alpha_{ik_i^*})}{A} + \frac{1}{A}[\ln(e^{-Af\pi} - e^{-A\pi}) - \ln(1 - e^{-Af\pi})]$$

To prove this relationship, consider inequality (1). In this case, we have

$$\alpha_{ik_i^*} e^{-Ay_{k_i^*}}[e^{-Af\pi} - 1] \leq e^{-Ay_i}[e^{-A\pi} - e^{-Af\pi}]. \tag{11}$$

Taking logs and simplifying yields the formula.

Condition (11) implies that a common shock, $y_i' = y_i - x_0$, has no impact on an investor's choice of partners, since the shock does not affect differences in incomes. The assumption that an investor would only hire a poorer friend implies $y_i \geq y_{k_i}$ when the inequality (1) is satisfied. A negative shock which affects the poor more then leads to an increase in the difference: $y_i' - y_{k_i^*}' \geq y_i - y_{k_i^*}$. Thus, if an investor hires a friend when the income distribution is y, the investor hires the friend when the income distribution is y'. By contrast, this difference in incomes decreases when the rich are affected more. A preferential contract that occurs with income distribution y' also occurs with income distribution y. QED.

Extension of Proposition 2 to DARA utilities. Recall, a utility function u displays Decreasing Absolute Risk Aversion (DARA) if $-u''/u'$ decreases with income. Say that payoffs and shocks are small relative to incomes if $\forall i, \pi, x(y_i) \ll y_i$.
Proposition A1. *Suppose $N_i \cap S_i = \varnothing$ and altruism levels are such that investors never hire friends whose income is higher than their own. Consider DARA utility and suppose that payoffs and shocks are small relative to incomes. Then, rank-preserving negative income shocks increase preferential contracting for all investors when the shocks affect the poor more and when the shocks are common.*
Proof: Let k denote i's preferred friend for incomes y. investor i provides a favor if $\alpha_{ik}[u(y_k+f\pi)-u(y_k)] \geq u(y_i+\pi)-u(y_i+f\pi)$. Since $\pi \ll y_i, y_k$, this is equivalent to

$$\alpha_{ik} f\pi u'(y_k) \geq (1-f)\pi u'(y_i)$$

Denote by $y_i' = y_i - x(y_i)$ and $y_k' = y_k - x(y_k)$ incomes after the shock. Since $x(y_i) \ll y_i$ and $x(y_k) \ll y_k$,

$[\alpha_{ik} f\pi u'(y_k') - (1-f)\pi u'(y_i')] - [\alpha_{ik} f\pi u'(y_k) - (1-f)\pi u'(y_i)] = \alpha_{ik} f\pi x(y_k)(-u'')(y_k) - (1-f)\pi x(y_i)(-u'')(y_i)$.

Since u displays DARA and $y_k \leq y_i$, $\frac{(-u'')}{u'}(y_k) \geq \frac{(-u'')}{u'}(y_i)$, which implies that $\frac{(-u'')(y_k)}{(-u'')(y_i)} \geq \frac{u'(y_k)}{u'(y_i)}$ and hence that

$$\frac{(-u'')(y_k)}{(-u'')(y_i)} \geq \frac{(1-f)}{\alpha_{ik} f}$$

and since $x(y_k) \geq x(y_i)$

$$\frac{(-u'')(y_k)s(y_k)}{(-u'')(y_i)s(y_i)} \geq \frac{(1-f)}{\alpha_{ik} f}$$

This shows that if $\alpha_{ik} f \pi u'(y_k) \geq (1-f)\pi u'(y_i)$, then $\alpha_{ik} f \pi u'(y_k') \geq (1-f)\pi u'(y_i')$ and hence

$$\max_{l \in N_i} \alpha_{il} f \pi u'(y_l') \geq (1-f)\pi u'(y_i')$$

and investor i also hires an unqualified friend, possibly different, following the shock. QED.

Proof of Proposition 3. By Lemma 1,

$$q = \sum_{i \in M} q_i = \sum_{i \in M} \left(\sum_j s_{ij} \right) \mathbb{1}[\alpha_{ik_i^*}[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})] \geq u(y_i + \pi) - u(y_i + f\pi)].$$

By Lemma 2 and given the assumption that $\forall i \in M, \sum_j s_{ij} = 1/|M|$, we have $q = \frac{1}{|M|} \sum_{i \in M} \mathbb{1}[y_i - y_{k_i^*} \geq \Delta]$. QED.

Proof of Proposition 4. (1) Like for Proposition 1, the result holds due to the concavity of u. Higher y_i decreases $[u(y_i + \pi) - u(y_i + f\pi)]$, which decreases the incentives for i to choose her skilled partner for any $j \neq k_i^*$; lower $y_{k_i^*}$ increases $\left[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})\right]$ which increases the left-hand side of 3 in all cases where $j \neq k_i^*$. Next, consider $j \in N_i$ and $j \neq k_i^*$. Higher y_j decreases $[u(y_j + \pi) - u(y_j)]$, which in turn decreases the relative importance of j in i's altruistic considerations.
(2) An increase in $\alpha_{ik_i^*}$ increases $\alpha_{ik_i^*}[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})]$ and decreases the incentives to hire any qualified agent. A decrease in α_{ij} decreases $\alpha_{ij}[u(y_j + \pi) - u(y_j)]$ and increases the incentives to hire k_i^* when j is qualified.
(3) An increase in f increases $\alpha_{ik_i^*}[u(y_{k_i^*} + f\pi) - u(y_{k_i^*})]$ and reduces $u(y_i + \pi) - u(y_i + f\pi)$. Both effects increase the incentives to hire a friend and entail a loss in output.
(4) Since $\alpha_{ij}[u(y_j + \pi) - u(y_j)] \geq 0$, the first binary indicator is always greater than or equal to the first. Therefore, changes in probabilities which remove weights from the second term and increase weights on the first term increase q_i. QED.

Proof of Proposition 6. Consider strong preferential contracts first. These occur when the investor is rich, has at least one poor friend and her qualified agent is not a poor friend. Note that a rich agent has exactly k poor friends with probability $\binom{n_P}{k}\rho^k(1-\rho)^{n_P - k}$. In that case, none of her poor friends is qualified with probability $\frac{n-1-k}{n-1}$. We can thus write:

$$\mathbb{E}(q) = (1-\lambda) \sum_{k=1}^{n_P} \binom{n_P}{k} \rho^k (1-\rho)^{n_P - k} \left[\frac{n-1-k}{n-1} \right]$$

We then make use of two classical combinatorial equalities. First, $\sum_{k=1}^{n_P} \binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} = 1-(1-\rho)^{n_P}$ is the probability that a rich agent has at least one poor friend. Second, $\sum_{k=1}^{n_P} k\binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} = \rho n_P$ is the expected number of poor friends of a rich agent. Substituting and simplifying yields the result:

$$
\begin{aligned}
\mathbb{E}(q) &= (1-\lambda) \sum_{k=1}^{n_P} \binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} \left[\frac{n-1-k}{n-1} \right] \\
&= (1-\lambda) \left[\sum_{k=1}^{n_P} \binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} - \left[\frac{1}{n-1} \right] \sum_{k=1}^{n_P} k \binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} \right] \\
\mathbb{E}(q) &= (1-\lambda) \left[1-(1-\rho)^{n_P} - \frac{\rho n_P}{n-1} \right]
\end{aligned}
$$

As a function of ρ, we have:

$$
(\mathbb{E}(q))'(\rho) = (1-\lambda) \left[n_P (1-\rho)^{n_P-1} - \frac{n_P}{n-1} \right]
$$

Therefore, $\mathbb{E}(q)$ increases from $\mathbb{E}(q)(0) = 0$ to a maximal value and then decreases to $\mathbb{E}(q)(1) = (1-\lambda) \left[1 - \frac{n_P}{n-1} \right]$. The maximal value is reached at

$$
\rho_{\max} = (1-\lambda) \left[1 - \frac{1}{(n-1)^{\frac{1}{n_P-1}}} \right]
$$

Next, consider weak preferential contracting, which occurs when the investor is rich, has at least one poor friend, and none of his (poor and rich) friends are qualified. A rich agent has exactly k poor friends and l rich friends with probability $\binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} \binom{n_R-1}{l} \rho_R^l (1-\rho_R)^{n_R-l}$, leading to

$$
\begin{aligned}
\mathbb{E}(q) &= (1-\lambda) \sum_{k=1}^{n_P} \sum_{l=0}^{n_R-1} \binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} \binom{n_R-1}{l} \rho_R^l (1-\rho_R)^{n_R-1-l} \frac{n-1-k-l}{n-1} \\
&= (1-\lambda) \sum_{k=1}^{n_P} \binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} \sum_{l=0}^{n_R-1} \binom{n_R-1}{l} \rho_R^l (1-\rho_R)^{n_R-1-l} \frac{n-1-k-l}{n-1} \\
&= (1-\lambda) \sum_{k=1}^{n_P} \binom{n_P}{k} \rho^k (1-\rho)^{n_P-k} \sum_{l=0}^{n_R-1} \binom{n_R-1}{l} \rho_R^l (1-\rho_R)^{n_R-1-l} \left[\frac{n-1-k}{n-1} - \frac{l}{n-1} \right] \\
&= (1-\lambda) \left[1-(1-\rho)^{n_P} - \frac{\rho n_P}{n-1} - (1-(1-\rho)^{n_P}) \frac{\rho_R (n_R-1)}{n-1} \right]
\end{aligned}
$$

As a function of ρ, we have:

$$
(\mathbb{E}(q))'(\rho) = (1-\lambda) \left[(1-\rho_R \frac{n_R-1}{n-1} n_P)(1-\rho)^{n_P-1} - \frac{n_P}{n-1} \right]
$$

Therefore, $\mathbb{E}(q)$ also increases from $\mathbb{E}(q)(0) = 0$ to a maximal value and then decreases to $\mathbb{E}(q)(1) = (1-\lambda)\left[1 - \frac{n_P+\rho_R(n_R-1)}{n-1}\right]$.QED.

Proof of Proposition 7. For a rich investor, the qualified agent is rich with probability $\frac{n_R}{n-1}$ and poor with probability $\frac{n_P-k}{n-1}$. From the reasoning in the main text, we obtain:

$$\mathbb{E}(\Delta W) = \frac{n_R}{n}\sum_{k=1}^{n_P} C_{n_P}^k \rho^k (1-\rho)^{n_P-k}[\frac{n-1-k}{n-1} f\pi(u'_L+u'_H) - \frac{n_R-1}{n-1}\pi 2u'_H - \frac{n_P-k}{n-1}\pi(u'_L+u'_H)]$$

Simplifying yields:

$$\mathbb{E}(\Delta W) = \frac{n_R}{n}[(1-(1-\rho)^{n_P})\frac{n_R-1}{n-1}\pi[fu'_L-(2-f)u'_H] - \frac{n_P}{n-1}(1-(1-\rho)^{n_P}-\rho)(1-f)\pi(u'_L+u'_H)]$$

Denote by $\Pi_1 = \pi[fu'_L - (2-f)u'_H]$ and $\Pi_2 = (1-f)\pi(u'_L + u'_H)$. If $\Pi_1 < 0$, then $\mathbb{E}(\Delta W) < 0$. Suppose $\Pi_1 > 0$. We have:

$$\frac{n}{n_R}\mathbb{E}(\Delta W) = (1-(1-\rho)^{n_P})(\frac{n_R-1}{n-1}\Pi_1 - \frac{n_P}{n-1}\Pi_2) + \rho\frac{n_P}{n-1}\Pi_2$$

Taking the derivative, we have

$$\frac{n}{n_R}\frac{\partial \mathbb{E}(\Delta W)}{\partial \rho} = n_P(1-\rho)^{n_P-1}(\frac{n_R-1}{n-1}\Pi_1 - \frac{n_P}{n-1}\Pi_2) + \frac{n_P}{n-1}\Pi_2.$$

Note that $(1-\rho)^{n_P-1}$ is decreasing in ρ. Note also that $\mathbb{E}(\Delta W))(\rho = 0) = 0$ and $\mathbb{E}(\Delta W))(\rho = 1) = \frac{n_R(n_R-1)}{n(n-1)}\Pi_1 > 0$.

There are two cases:

(1) If $n_P(\frac{n_R-1}{n-1}\Pi_1 - \frac{n_P}{n-1}\Pi_2) + \frac{n_P}{n-1}\Pi_2 > 0$, then $\mathbb{E}(\Delta W)$ is increasing in ρ, and hence $\mathbb{E}(\Delta W) > 0$.

(2) If $_P(\frac{n_R-1}{n-1}\Pi_1 - \frac{n_P}{n-1}\Pi_2) + \frac{n_P}{n-1}\Pi_2 < 0$, the first term is negative and initially dominates the second term. In that case, $\mathbb{E}(\Delta W)$ is first decreasing and then increasing. Thus, we have $\mathbb{E}(\Delta W) < 0$ for low values of ρ and then $\mathbb{E}(\Delta W) > 0$ if ρ is high enough. QED.

Extension of Proposition 7 to weak preferential contracting. Under weak preferential contracting, we obtain

$$\begin{aligned}\mathbb{E}(\Delta W) = (1-\lambda)\pi \quad [\quad & \frac{n_R-1}{n-1}(1-(1-\rho)^{n_P})(1-\rho_R)(fu'_L-(2-f)u'_H) - \\ & \frac{n_P}{n-1}(1-(1-\rho)^{n_P}-\rho)(1-f)(u'_L+u'_H)]\end{aligned} \tag{12}$$

Comparing (12) with equation (10) for strong preferential contracting, we see that the first term is multiplied by $(1-\rho_R)$. This term accounts for the fact that when the investor and qualified agent are rich, the investor hires a poor friend only when the rich qualified agent is not a friend. We then have the following result for weak preferential contracting and welfare:

Proposition A2. For $\alpha\frac{f}{1-f+\alpha} \leq \frac{u'_H}{u'_L} \leq \alpha\frac{f}{1-f}$ (weak preferential contracting),
(1) If $fu'_L - (2-f)u'_H < 0$*, then* $\mathbb{E}(\Delta W) < 0$ *for* $\rho > 0$*.*
(2) If $fu'_L - (2-f)u'_H > 0$ *and if* $(n_R-1)(1-\rho_R)(fu'_L-(2-f)u'_H) > (n_p-1)(1-f)(u'_L+u'_H)$*, then* $\mathbb{E}(\Delta W) > 0$ *for* $\rho > 0$*.*
(3) If $fu'_L - (2-f)u'_H > 0$ *and if* $(n_R-1)(1-\rho_R)(fu'_L-(2-f)u'_H) < (n_p-1)(1-f)(u'_L+u'_H)$*, then there exists a* ρ^* *such that* $\mathbb{E}(\Delta W) < 0$ *if* $\rho < \rho^*$ *and* $\mathbb{E}(\Delta W) > 0$ *if* $\rho > \rho^*$*.*

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